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The Effect of Discovery Learning to Students' Mathematics Performance

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Abstract: This quasi-experimental research was conducted to determine the effect of discovery learning to the academic performance of students. The participants of the study were randomly selected seventy (70) Grade 10 students in Mathematics class. Two (2) sections with 35 students each were the control and experimental groups. The findings showed that students did not meet the expectation in terms of the level of their performance in Mathematics before the intervention. After the intervention, the level of performance of the experimental group advanced to very satisfactory and the non-experimental group advanced to satisfactory. Significant differences were noted between the pre-test and post-test scores of each group. This shows that both of the interventions have a positive effect on students' performance in Mathematics. Comparing the post-test scores between the control and experimental groups, significant difference was recorded indicating the discovery learning group has higher mathematics performance compared to non-discovery learning group.

Keywords: mathematics achievement, discovery learning, teaching strategy, mathematics education.

Introduction

Although there have been much debate and significant movement away from the traditional methods of teaching, which mostly relied on the transference of knowledge from the teacher to the students, there are still schools that use these methods and teaching strategies. Teachers often talk about improved strategies but it is also important to implement them.

Mathematics teachers tend to place too much focus on the instructional strategy, where the teacher is the one who does the talking, while the students listen; this is still the norm in other classrooms (Harasim, 2017). The teacher spends most of the time talking and explaining when he or she should rather adopt approaches that are less dependent on transmission and more participatory (Wilson & Peterson, 2006). When one talks about participatory methods most teachers associate student participation with group work, but this is not necessarily the case. There are other techniques that can be used to ensure that understanding of mathematical concepts takes place. These include getting the students to show their understanding through demonstration or discovery learning.

Teaching students with the notion of discovering, critical thinking, questioning, and problem-solving skills is one of the main principles of mathematics teaching. Thus, mathematics teaching curriculum should accordingly be developed to educate math-numerate students who are able to inquire and solve problems they face. Today, it is believed that methods in accordance with the constructivist approach in which the students learn more effectively by constructing their own knowledge, should be used (Mayer, 2004). One of these methods is discovery learning. The basis of mathematics teaching understands that natural phenomena and the nature of math require inquiring and discovering. Bruner (2009) points out that any individual has the will to learn and this will be used in such activities that it should raise curiosity and direct students to studying and discovering knowledge.

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According to Bruner (2009), discovery learning stresses reflecting, thinking, experimenting, and exploring. People who learn through self-discovery are more self-confident. Discovery is a way from the unknown to the known by the learners themselves. The active participation of the learner in the learning process is called discovery learning. In discovery learning, students construct knowledge based on new information and data collected by them in an explorative learning environment (Njoo, 1994).

Thus, this study ascertained the effect of discovery learning as teaching strategy to mathematics performance.

Methodology

This study used the quasi-experimental pre-test-post-test design to determine the effect of discovery learning approach to students' mathematics performance. According to Shuttleworth (2008), this design is a powerful tool in regulating the different threats in the study.

The participants of the study were the seventy (70) Grade 10 junior high school students in mathematics which comprised the two groups, each with thirty-five (35) students. One group was exposed to discovery learning while the other group was exposed to non-discovery learning teaching method. To determine whether the two groups were comparable at the start of the experiment, a pre-test was used. Moreover, it also suggested the homogeneity of two groups.

To establish the achievement of students in each group, the researchers constructed lesson plans in circles and plane coordinate geometry in each teaching methods. It was validated by different experts in the field of mathematics and was used by the researchers for the period of six weeks. Moreover, an 80-item multiple choice test was also constructed with the Table of Specifications (TOS) to make sure that the test items jived with the competencies and were fairly distributed. It was also validated and reliability tested with KR_{20} value which is equivalent to 0.78. Only 40 items were finally decided to be used for the pre-test and post-test to determine the students' performance. The instruments primarily focused on the topics about circles, and plane coordinates geometry which was based on the curriculum guide used under the K to 12 Basic Education Curriculum.

Each group was oriented to the different interventions a week before the actual intervention stage. This motivated the students and made them realized of their respective responsibilities as the main participants of the study. The validated lesson guides for each group were used during the 6-week intervention stage. However, these lesson guides were modified to suit learners' needs. In the non-discovery learning group. The teacher discussed the lessons and present some examples during the class. Also, students were given exercises for the to solve at the end of the lessons.

On the other hand, the group which was exposed to discovery learning were given on the first day a problem, a question, a scenario or an activity to work on (either individually or by small group). After the activity, each group (or a number of individual) discussed their results in class and the teacher guided them to come up with the expected result. At the end of the six-week period, the same 40 item multiple-choice test in mathematics was administered as post-test, only that the items were renumbered.

Results and Discussions

Pre-test and post-test performance of students exposed to discovery learning approach and non-discovery learning approach

Result revealed that the pre-test of students in the discovery learning approach ($M = 9.94$, $SD = 2.45$), and in the non-discovery learning approach ($M = 9.91$, $SD = 2.11$) were "fairly satisfactory". This low performance result might have been due to the students' possession of minimum knowledge and skills and core understandings of the topics in mathematics, but still needed help throughout the performance of authentic tasks. Results of the standard deviation showed that the spread of scores of both groups were nearly the same in terms of their

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performance which means that the two groups are homogenous with regards to their pre-test performance in mathematics.

After the intervention, the post-test performance of students in the discovery learning (M = 25.34, SD = 2.45) was "very satisfactory" while in the traditional method (M = 24.11, SD = 2.07) was "satisfactory". This means that students who were under the discovery learning approach group and traditional method group had improved their performance.

Table 1. Pre-test and Post-test Performance of Students Exposed to Discovery Learning Approach and Non-Discovery Learning Approach

	N	Mean	SD	Description
Pre-test				
Discovery Learning	40	9.94	2.45	Fairly Satisfactory
Non- Discovery Learning	40	9.91	2.11	Fairly Satisfactory
Post-test				
Discovery Learning	40	25.34	2.45	Very Satisfactory
Non- Discovery Learning	40	24.11	2.07	Satisfactory

Note: (33.00–40.00) Outstanding; (25.00–32.99) Very Satisfactory; (17.00–24.99) Satisfactory; (9.00–16.99) Fairly Satisfactory; and (0.00–8.99) Did Not Meet Expectations.

Difference in the pre-test performance of students exposed to discovery learning approach and those exposed to non-discovery learning approach

Result revealed no significant difference in the pre-test performance of the participants exposed to discovery learning approach (*M = 9.94, SD = 2.45*) and those exposed to traditional method (*M = 9.91, SD = 2.11; t(68) =0.052* , and *p =.960* (two-tailed). This indicates that the performance of the students in two treatments were similar before the start of the experiment and therefore comparable and both groups had the same level of prior knowledge and skills in mathematics before the intervention.

Table 2 Difference in the Pre-test Performance of Students Exposed to Discovery Learning Approach and those Exposed to Non-Discovery Learning Approach

	Mean	SD	Mean Difference	CI Lower	Upper	t	df	p
			.03	-1.12	1.06	.052	68	.960
Discovery Learning Approach	9.94	2.45						
Non-Discovery Learning Approach	9.11	2.11						

Difference in the pre-test and post-test performance of students exposed to discovery learning approach and those exposed to non-discovery learning approach

Results revealed a statistically significant increase in students' mathematics performance in the discovery learning approach from pre-test (*M = 9.94, SD = 2.45*) to post test (*M = 25.34, SD = 2.45); t(34) = 24.187, p = 0.00*1 (two tailed). On the other hand, in terms of non-discovery approach, result also revealed a statistically significant increase in students' mathematics performance from pre-test (*M = 9.91, SD = 2.11*) to post test (*M = 24.11, SD = 2.07*) *t(34) = 30.639, p = 0.001*(two tailed). Thus, it can be said that students are capable of learning or understanding the concepts regardless of the teaching instructions employed by the teacher. Moreover, both instructional methods used had helped in understanding mathematics concepts. Participants in discovery learning had developed the fundamental knowledge and skills and can transfer these understandings through authentic tasks while participants in traditional method had

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developed the fundamental knowledge and skills and with little guidance. Hence, both methods are effective in developing students' understanding in mathematics.

Table 3 Difference in the Pre - test and Post - test Performance of Students Exposed to Discovery Learning Approach and those Exposed to Non-Discovery Learning Approach

	Mean	SD	Mean Difference	CI Lower	CI Upper	t	df	p
Discovery Learning Approach			15.40	-16.69	-14.11	24.187	34	0.001*
Pretest	9.94	2.45						
Posttest	25.34	2.45						
Non-Discovery Learning Approach			14.20	-15.14	-3.26	30.639	34	0.001*
Pretest	9.91	2.11						
Posttest	24.11	2.07						

Difference in the post-test performance of students exposed to discovery learning approach and those exposed to traditional method

The results revealed that there was a significant difference in the post-treatment performance of the students exposed to discovery learning approach (*M = 25.34, SD = 2.45*) and non-discovery learning approach (*M = 24.11, SD = 2.07*); *t(68) = 2.267 , and p = 0.027* (two-tailed). This implies that the post-test performance of the students exposed to discovery learning approach was higher than the post-test performance of those exposed to non-discovery learning approach. This conforms to the study of Montgomery (2015) in which discovery learning approach was statistically effective compared to other instructional methods among the middle school students' achievement.

Table 4 Difference in the Post-test Performance of Students Exposed to Discovery Learning Approach and those Exposed to Non-Discovery Learning Approach

	Mean	SD	Mean Difference	CI Lower	CI Upper	t	df	p
			1.229	-2.31	-0.15	2.267	68	0.027*
Discovery Learning Approach	25.34	2.45						
Non-Discovery Learning Approach	24.11	2.07						

Conclusions

Students improved significantly in their performance in mathematics after they had been exposed to discovery learning approach and traditional teaching approach. It showed that both methods elicit progress in learners' understanding provided that appropriate intervention is given. However, teaching using either discovery learning or traditional method may enhance students' level of understanding and would in turn, increase their level of performance provided it was administered properly. Traditional method (non-discovery approach) when properly planned and prepared can be utilized in teaching to stimulate the mind of students and made them better prepared before coming to class. On the other hand, the utilization of guided activities in discovery learning engaged students to think and put meaning to their answers which helped them develop their level of understanding. Likewise, teaching using the discovery learning approach affects the performance of the students. It made students participate in class actively and improved their communication skills as well as their level of confidence.

Moreover, the results imply that although both methods of instruction yield a positive effect on the performance of the students, yet discovery learning approach is much better compared to traditional method. Furthermore, the results revealed that new and emerging strategies or

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methods of instruction in teaching the subject could be interesting and worthwhile on the part of the students. The researcher concluded that the use of discovery learning approach is better compared to traditional method as it yields much higher improvement in the students' performance. It showed that students have to exert extra effort in the process of teaching-learning, however, results proved to be rewarding in the long run.

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